



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/662,522	09/16/2003	Anthony Dip	241482US6YA	1707
22850 7590 06/01/2007 OBLON, SPIVAK, MCCLELLAND, MAIER & NEUSTADT, P.C. 1940 DUKE STREET ALEXANDRIA, VA 22314			EXAMINER STOUFFER, KELLY M	
			ART UNIT	PAPER NUMBER
			1762	
			NOTIFICATION DATE	DELIVERY MODE
			06/01/2007	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentdocket@oblon.com
oblonpat@oblon.com
jgardner@oblon.com

Office Action Summary

Application No.

10/662,522

Applicant(s)

DIP ET AL.

Examiner

Kelly Stouffer

Art Unit

1762

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 May 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,4-13,20-23,25,26,33-38,52,65,83 and 84 is/are pending in the application.
- 4a) Of the above claim(s) 65 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,4-13,20-23,25,26,33-38,52,83 and 84 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☒ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☐ Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- ☐ Notice of Informal Patent Application
- ☐ Other: _____

DETAILED ACTION

1. The examiner acknowledges the cancellation of claims 24, 29-32, 55-56, 59-62, and 78-82.

Continued Examination Under 37 CFR 1.114

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 7 May 2007 entered.

Response to Arguments

3. Applicant's arguments filed 7 May 2007 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Art Unit: 1762

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
 2. Ascertaining the differences between the prior art and the claims at issue.
 3. Resolving the level of ordinary skill in the pertinent art.
 4. Considering objective evidence present in the application indicating obviousness or nonobviousness.
4. Claims 1, 4-13, 20-21, 23, 25-26, 33, 52 and 83-84 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent publication 2003/0176060 to Doan et al. in view of US Patent publication 2004/0043149 to Gordon et al.

Regarding claims 1, 4-7, 20-21, 23, and 33, Doan et al. includes a method of forming HfO_2 on a semiconductor substrate (abstract lines 1-2) by ALD, comprising providing a plurality of substrates 82 in Figure 4. As one can see from the figure, the substrate diameter is dependant upon the size of the reaction chamber. One of ordinary skill in the art would recognize that substrate size would also be modified depending upon desired applications of the substrate (i.e. semiconductor applications as given in Doan et al. et seq.) Therefore, substrate size is a result effective variable and its modification is not inventive, absent evidence showing a criticality for the claimed values. The coating is performed in a reaction chamber 52 with a holder 80 that may be considered a tier substrate holder of a batch type processing system at least as broadly defined by the applicant, and the holder 80 holds substrates 82 (which number less than 100) in Figure 4. As for chamber pressure and substrate temperature, Doan et al. teaches in paragraph 0024 et seq. that substrate temperatures

Art Unit: 1762

and pressure in the chamber vary with conditions of ALD such as particular precursors used, layer composition, deposition equipment and other factors. The variables of substrate temperature and pressure in the chamber therefore depend upon the conditions and apparatus employed in carrying out the invention. (see also paragraph 0022 et seq.) Their importance lies in impacting monolayer formation and the quality desired in the ALD layer. These variables are modified by routine experimentation, are result-effective, and thus are not inventive. It would have been obvious to one of ordinary skill in the art at the time of invention to modify Doan et al. by routine experimentation to include a substrate temperature of 1100-600 °C, and a pressure of 0.05 to 2 torr in order to form a film by ALD of a desired quality and monolayer formation absent evidence showing a criticality for the claimed ranges commensurate in scope with the claims. Doan et al. describes flowing a pulse of hafnium containing precursor into the chamber but does not include the required precursors or a liquid evaporator. Gordon et al. teaches using these precursors to make hafnium oxide films (abstract, Table 1) in order to form highly uniform films with ALD (paragraph 0087). Gordon et al. also cites this advantage over the Hf precursor used by Doan et al. in paragraph 0087. One of ordinary skill in the art would have a reasonable expectation of success that Gordon et al. will work in a batch process, as the ALD process used by Gordon et al. is a self-saturating process, in which the gases may be pulsed until all desired surfaces are reacted and coated (paragraph 0102) and the process coats all sizes of substrates and even the chamber walls (paragraph 0107).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Doan et al. to include the precursors of Gordon et al. in order to make hafnium oxide films that are highly uniform.

Gordon et al. additionally includes the evaporator requirements of the claim shown in Figure 1. It is also noted that many of the process parameters rendered result effective variables by Doan et al. may be found in Gordon et al. Example 12, among other areas in the reference. As for the precursor and reactant gas flow rates, Gordon et al. states that by reducing the velocity of the precursor, one receives better step coverage (paragraph 0134). Therefore these variables are modified by routine experimentation and is not inventive, absent evidence showing a criticality of the claimed ranges.

Doan et al. discloses repeating processes until hafnium oxide with desired properties (i.e. thickness, etc.) is formed (paragraphs 0005 and 0042 et seq.). Doan et al. also discloses forming a film with acceptably constant properties (such as formation of a monolayer of material in paragraph 0051, low contamination in paragraph 0057, or uniform oxygen coverage in paragraph 0065) across all the substrates in the tier substrate holder.

Regarding claims 8-10, Gordon et al. discloses flowing carrier gases with reactant and precursor gases (paragraph 0095 or 0098) in order to speed the flow of reactants into the chamber. The flow rate of carrier gas must be sufficient to achieve this task, and maintain chamber pressure and purging of the vapor. Therefore, the

Art Unit: 1762

modification of flow rate is by routine experimentation and is not inventive, absent evidence showing a criticality for the claimed range.

Regarding claims 11-13, both Doan et al. and Gordon et al. use water or other oxygen containing species (Doan et al. paragraph 0021 lines 1-5, Gordon et al. Example 12).

Regarding claims 25-26, Gordon et al. describes pulse duration of precursor and reactant gas as a function of surface coverage and saturation (paragraphs 0102 and 0107). These variables are therefore result effective and their modification is not inventive absent evidence showing criticality for the claimed ranges.

Regarding claim 52, Gordon et al. discloses isothermal heating in paragraph 0107.

Regarding claims 83-84, the films are described as stoichiometric or non-stoichiometric in Doan et al. paragraph 0042 and stoichiometric in Gordon et al. Example 12.

5. In addition, claims 1, 4-13, 20-21, 23, 25-26, 33, 52 and 83-84 are also rejected under 35 U.S.C. 103(a) as being unpatentable over Doan et al. and Gordon et al. in view of US patent number 6572705 to Suntola et al. Doan et al. and Gordon et al. the

Art Unit: 1762

limitations described above except for explicitly providing a substrate with a diameter greater than 195 mm (though it would be obvious to modify the references on their own depending on chamber size). Suntola et al. teaches that ALD successfully deposits films on large substrates (e.g. 300 mm in diameter) in column 11 line 20 to improve process throughput.

It would have been obvious to one of ordinary skill in the art at the time of invention to modify Doan et al. and Gordon et al. to include a substrate with a diameter greater than 195 mm as taught by Suntola et al. to improve process throughput.

6. Claims 22, 34-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Doan et al. and Gordon et al. in view of US Patent number 6607973 to Jeon. Doan et al. and Gordon et al. are described above and include an HfO_2 film deposited on a substrate by ALD. Doan et al. or Gordon et al. do not include an interfacial layer between the substrate and the HfO_2 film. Jeon teaches that surface preparation in the way of an interfacial layer shown in Figures 1-3 leaves a substrate terminated with hydroxyl groups in column 3 lines 23-29. One of ordinary skill in the art would recognize that having a surface terminated with hydroxyl groups would make the surface more reactive towards the Hf precursor gas.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Doan et al. and Gordon et al. to include an interfacial layer between the HfO_2 and the substrate as taught by Jeon in order to have a surface terminated with hydroxyl groups therefore having a surface more reactive towards the Hf precursor gas.

With regard to claims 34-36, Jeon discloses the thickness of the metal compound layer to be less than or equal to 50 Å.

With regard to claim 37, Jeon anneals the HfO_2 containing film to 300-900 °C in column 4 lines 55-60.

With regard to claim 38, Jeon deposits a film containing Si on top of the HfO_2 layer in Figures 5-7 that may be considered an electrode film.

7. Similarly, claims 22, 34-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Doan et al., Gordon et al., and Suntola et al. in view of US Patent number 6607973 to Jeon.

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Yeo et al. (US 2004/0033661) shows similar Hf precursors with a similar technique.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Kelly Stouffer whose telephone number is (571) 272-2668. The examiner can normally be reached on Monday - Thursday 7:00-5:30.

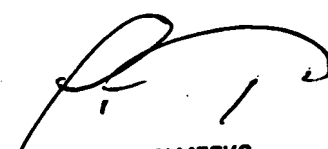
Art Unit: 1762

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Meeks can be reached on (571) 272-1423. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Kelly Stouffer
Examiner
Art Unit 1762

kms



TIMOTHY MEEKS
SUPERVISORY PATENT EXAMINER